PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in and relating to Heat Exchange Devices.

We, ERNST MENZEL, of Bachstrasse 2, Elberfeld, Germany, a German citizen, and MENZEL AKTIENGESELLSCHAFT, of the same address, a German company, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to heat exchange devices for gases, vapours or liquids, and more especially to such devices as used for the treatment of ammonia, benzol and the like.

In heat exchangers hitherto utilised in the various branches of industry, for example for the treatment of benzol, ammonia and the like, numerous disadvantages are apparent, the most obvious being on the score of economy, where due to the limitation of the active surface area as compared with the actual surfaces provided in the apparatus for the exchange of heat between the circulating media, and also due to pockets being formed in the different currents, the aggregate result being a great wastage of heat. In such apparatus the tubes are usually made of wrought iron, which, because of its very inferior resistance to the corrosive action of acidulated media, possesses but a very short life, and thus the scope of application of tubular apparatus is correspondingly limited, while such apparatus has the further disadvantage of its numerous joints between the tubes and bends leading to difficulty in erection and assembly, and the very unsatisfactory flow of the media circulating in the tubes, which disadvantages bias the tubular heat exchanger as compared with heat exchange apparatus composed of plates or tongues. Even, however, in the case of plate exchangers the highest possible efficiency is not obtained because of the inferior utilisation of the surfaces present.

In some heat exchange devices of plate construction the two media circulating between and over the plates are left to take their own path, whereat they choose the shortest, that is, the way having least resistance, and therefore, do not cover the whole of the active surface, and are not consequently, exposed to the temperatures prevailing at such points as they do not contact with.

In order to eliminate this disadvantage it has been proposed to provide ribs on the plates, which ribs, nevertheless, were unable to ensure that the whole of the area of the plates came into direct and unconditional contact with the medium. Moreover the erection of the plate apparatus, and particularly the making of the tight joints where the ribs abutted against upper and lower plates presented considerable difficulties.

In the case of heat exchange columns fitted with so called tongue plates the high difference in temperature of the fluids circulating in the device, would not be fully utilised because of the design of the tongue which separates the current into two parts, the fluid flowing along the latter giving the greater part of its heat to the separating wall without production of useful work, because the other medium or fluid impinged on the tongues in a stream approximately equal to the entrance and exit conduits, choosing the shortest path between said entrance and exit conduits. Consequently, even in the case of columnar apparatus it is impossible to obtain the highest efficiency, due to the fact that the whole of the available surface cannot be rendered active.

In accordance with the present invention a heat exchange device for gases, vapours, or fluids, includes stacks of superimposed plates corrugated in such manner that the media flowing through the device in contraflow are directed over opposite sides of a plate in predetermined serpentine paths embracing the whole of the available area of the plates, whereby to effect maximum transmission between the media.

In a preferred embodiment the corrugations are so disposed that the media under treatment are submitted to frequent changes in direction in order to prevent the formation of pockets or stagnant pools, the presence of which impairs the efficiency of the device.

A feature of the construction according to the present invention lies in the fact

that the exchange media are caused to follow paths which are fully separated from one another by the thickness of the material of the exchange plates thereby ensuring a maximum contact area; a further feature is that the corrugations themselves increase the available area of each plate thus further enhancing the efficiency of the device.

The said corrugations may or may not be of equal upper and lower cross section, depending on the media to be treated, and it is possible to construct columns of plates with corrugations of varying size, so that the stream guiding corrugations from plate to plate can increase or decrease in cross section as desired, which is an especially valuable feature in the case of cooling and condensing a vapour the volume of which decreases with condensation.

The accompanying drawings illustrate diagrammatically by way of example, several embodiments of columnar apparatus according to the present invention.

In said drawings:

Figs. 1 to 4 represent vertical sections of apparatus constructed in accordance with this invention; and

Figs. 5 to 10 are plan views illustrating the direction in which the corrugations cause the medium to flow.

Referring now to the drawings, *a* represents the plates which constitute the column and which possess in their upper and lower surfaces corrugations *c* of the cross section as shown in Figs. 1 to 4, or if desired, of any cross sections found suitable. The said corrugations are distributed over the whole surface of the plates *a* and are arranged to correspond to the outer shape of the latter, the circular formation being illustrated in Figs. 5 to 7 inclusive, while square or rectangular arrangements are illustrated in Figs. 8 to 10. The corrugations *c* at each outer edge are interconnected so as to produce frequent changes of direction, while such changes of direction can be effected over the surface of the plate by means of labyrinth or convolute arrangements illustrated in Figs. 5 to 7, or alternatively by the zigzag corrugation of the construction illustrated in Figs. 8 to 10.

The plates *a*, which may be made of any suitable material, have their edges sealed at *g*, such seal consisting for instance of flanges formed on the said plates, which in the completed column constitute the outer shell. The heat exchange column can be composed of plates, the corrugations *c* of which are similarly arranged and wherein a similar plate is inserted and is superimposed on each succeeding plate, so that the apices of the corrugations coincide with those of the adjacent plates as may be seen from Figs. 2 and 4, while partitions *b* may be provided where necessary to fittingly screen the corrugations *c* from each other. It is also permissible that the size and section of the corrugations in the various plates be varied somewhat, but it is important that those of the one plate coincide with those of the other plate, and that therefore, the edges of such corrugations should also coincide.

As will be seen, the partitions *b* may only be necessary when the plates are assembled with the same side uppermost for when an upper plate is inverted it forms with the lower adjacent plate a series of complete conduits for the circulating fluid. The different storeys of the apparatus are connected by means of conduits *d* and *e* in the usual way so that the two fluids, the temperature of which it is intended to affect, are conducted through the apparatus in counter flow.

The upper and lower seals of the columns have been omitted from the apparatus illustrated, which, as will be seen, permit of the circulation of gases, vapours or fluids under considerable pressure, which is a considerable advantage in some industries.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A heat exchange device for gases, vapours or fluids, including stacks of superimposed plates corrugated in such manner that the media flowing through the device in contra flow are directed on opposite sides of each plate in predetermined serpentine paths embracing the whole of the available area of the plates, whereby maximum transmission may be effected.

2. A heat exchange device according to Claim 1, more especially for the treatment of benzol, ammonia and the like wherein the corrugations are so constructed as to cause the media under treatment to frequently effect change of direction and thereby prevent the formation of pockets or stagnant pools.

3. A heat exchange device according to Claim 1, comprising a column of superimposed plates, each plate being provided with a series of corrugations directing the flow of the media thereover and conduits connecting different layers of the columnar device in such manner that the media under treatment are caused to flow therethrough in contra flow.

4. A heat exchange device according to Claims 1—3, wherein the plates are pro-

vided with peripheral sealing flanges which when assembled constitute the outer shell of the column and prevent escape of the media.

5. A heat exchange device according to Claim 1 constructed and adapted to operate substantially as described with reference to Fig. 1, 2, 3 or 4 of the accompanying drawings.

6. A heat exchange device according to Claim 1, with elements having corrugations or the like arranged in convolute or labyrinth formation substantially as described with reference to Fig. 5, 6 or 7 of the accompanying drawings.

7. A heat exchange device according to Claim 1, with elements constructed and adapted to operate substantially as described with reference to Figs. 8, 9 and 10 of the accompanying drawings.

Dated the 14th day of July, 1927.
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Fig.1

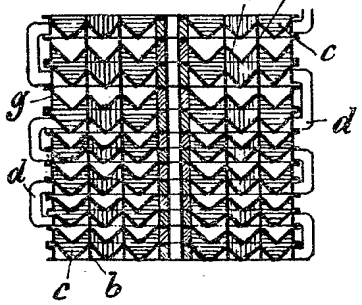


Fig.2

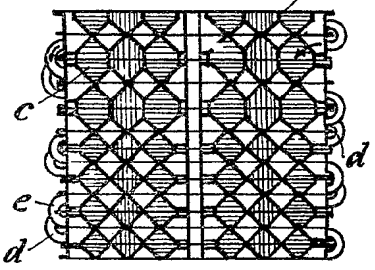


Fig.3

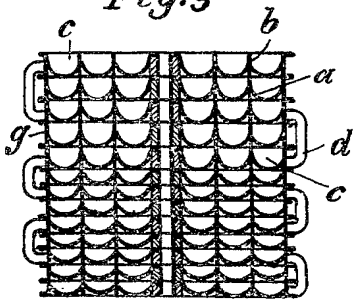


Fig.4

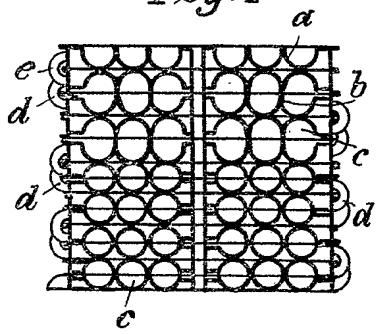


Fig.5

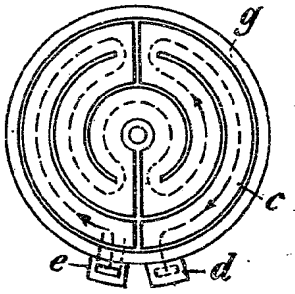


Fig.6

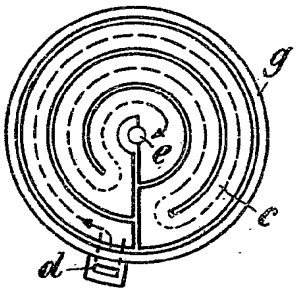


Fig.7

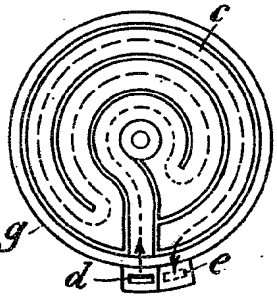


Fig.8

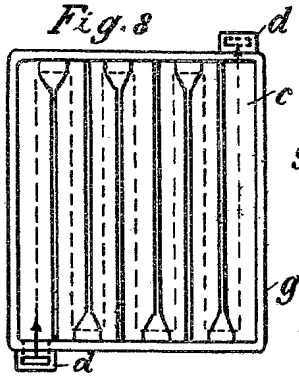


Fig.9

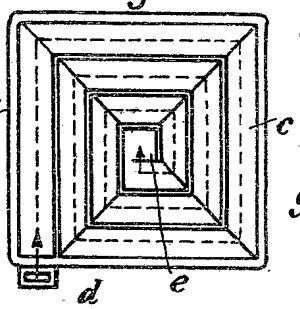
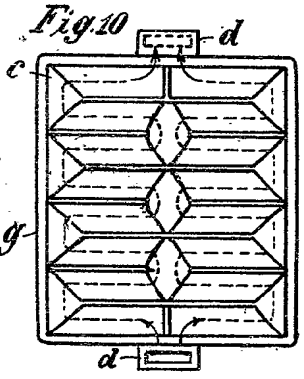


Fig.10



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